



PULSAR®
R96 RADAR

Pulsar® Model R96 Pulse Burst Radar Level Transmitter

DESCRIPTION

The Pulsar® R96 Radar transmitter is the latest generation of Magnetrol® 24 VDC, loop-powered, non-contact radar transmitters. Enhanced performance and innovative diagnostics bring simplicity to an often complicated technology.

This latest entry into the radar level measurement field is designed to provide unparalleled performance and ease of use. PULSAR non-contact radar is the perfect compliment to the MAGNETROL Eclipse® Model 706 Guided Wave Radar transmitter. Together, these transmitters offer the ultimate solution to the vast majority of process level applications.

TECHNOLOGY

The PULSAR Radar transmitter is based on pulse burst radar technology combined with equivalent time sampling circuitry. Short bursts of 6 GHz microwave energy are emitted and subsequently reflected from the liquid level surface. Distance is calculated by the equation $D = \text{Transit time (round-trip)}/2$. Liquid level is then calculated by applying the tank height value.

APPLICATIONS

MEDIA: Liquids and slurries; hydrocarbons to water-based media (dielectric 1.7–100)

VESSELS: Most metal and concrete process or storage vessels up to rated temperature and pressure. Pits and sumps as well as glass-lined tanks.

CONDITIONS: Virtually all level measurement and control applications including process conditions exhibiting varying specific gravity and dielectric, visible vapors, high fill/empty rates, turbulence, low to moderate foam and buildup.



FEATURES

- Multivariable two-wire, 24 VDC loop-powered transmitter for level or volume
- Performance not process dependent (changing specific gravity and dielectric have no effect)
- 6 GHz operating frequency offers superior performance in the tougher applications with turbulence, foam, and heavy vapors
- Echo Rejection setup is simple, intuitive and effective
- Antenna designs to +400°F (+200°C), -14.7 to 750 psig (-1.0 to 51.7 bar)
- Range up to 130 feet (40 meters)
- Quick connect/disconnect antenna coupling allows vessel to remain sealed
- Extremely low output at antenna: < .01 mW (avg), < 2 mW (max); hundreds of times less than a cell phone
- 4-button keypad and graphic LCD display allow for convenient viewing of configuration parameters and echo curve
- Proactive diagnostics advise not only what is wrong, but also offer troubleshooting tips
- Available for use in SIL 2 Loops (92.7% SFF, with full FMEDA report available)
- PACTware™ PC Program and enhanced DTMs for advanced configuration and troubleshooting
- Available with HART® or FOUNDATION fieldbus™ digital output

TECHNOLOGY

PULSE BURST RADAR

PULSAR R96 is a top-mounted, downward-looking pulse burst radar operating at 6 GHz. Unlike true pulse devices (e.g. ECLIPSE Guided Wave Radar) which transmit a single, sharp (fast rise-time) waveform of wide-band energy (Figure 1), PULSAR emits short bursts of 6 GHz energy (Figure 2) and measures the transit time of the signal reflected off the liquid surface.

Distance is calculated utilizing the equation Distance equals the Speed of light multiplied by the transit time divided by two ($Distance = C \times Transit\ Time/2$), then developing the level value by factoring in tank height and other configuration information (Figure 3). The exact reference point for distance and level calculations is the sensor reference point (bottom of an NPT thread, top of a BSP thread, or face of a flange).

The exact level measurement is extracted from false target reflections and other background noise via the use of sophisticated signal processing. The new PULSAR Model R96 circuitry is extremely energy efficient so no duty cycling is necessary to accomplish effective measurement.

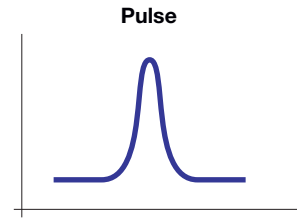


Figure 1

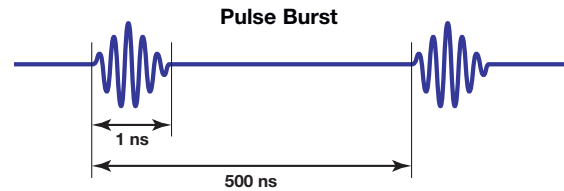


Figure 2

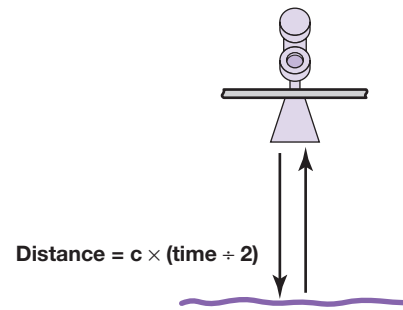


Figure 3

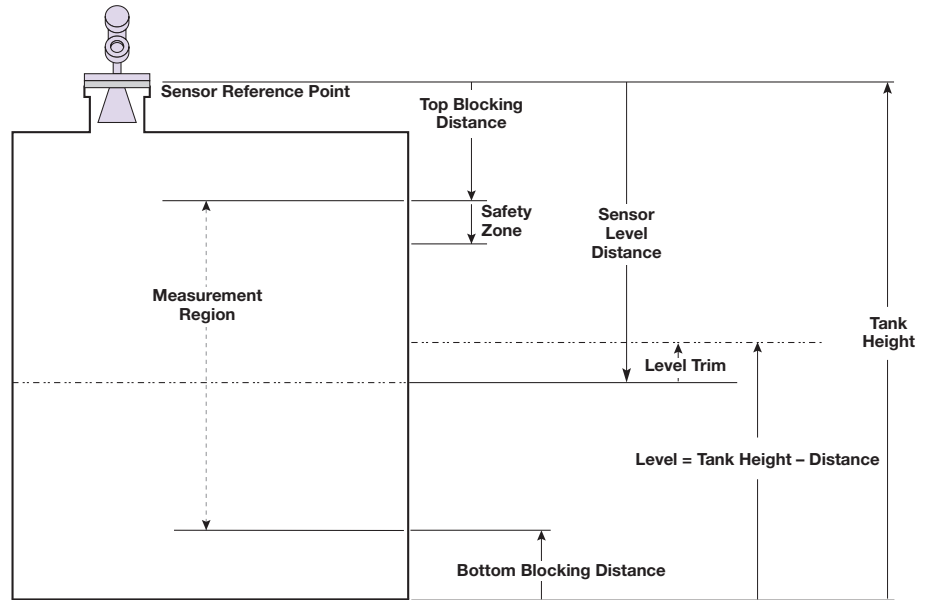
OPERATIONAL CONSIDERATIONS

Radar applications are characterized by three basic conditions:

- Dielectric (process medium)
- Distance (measuring range)
- Disturbances (turbulence, foam, false targets, multiple reflections and rate of change)

The PULSAR R96 Radar transmitter is offered with four antenna configurations:

- Polypropylene Dielectric Rod
- TFE Dielectric Rod
- All-Plastic Dielectric Rod: Polypropylene or Halar®
- 4" (100 mm) Horn
- 6" (150 mm) Horn



$$\text{Distance} = \text{Sensor Level Distance} - \text{Level Trim}$$

Figure 4

Maximum measuring range (distance) is measured from the sensor reference point (bottom of NPT thread, top of BSP thread, or face of flange) to the bottom of the tank. Refer to Figure 4.

Ideally, the 6" (150 mm) horn antenna should be used to ensure the best possible performance in all operational conditions. Since that is impractical, other antennas are available. The chart below shows the maximum measuring range of each antenna based on dielectric and turbulence. Refer to Figure 5.

Noise and media buildup drastically decrease reliable measurement. Although it is theoretically possible to measure a liquid level on the antenna, liquid should not be allowed closer than 2 inches (50 mm) from the bottom of the antenna due to the decrease in accuracy when liquid level is present on the antenna. Refer to Figure 6.

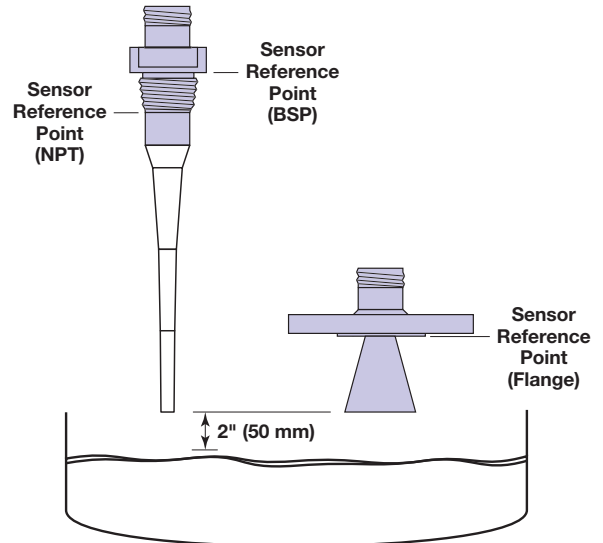


Figure 6

R96 Maximum Recommended Measuring Range in feet (meters)						
Dielectric > Antenna Type	Turbulence None or Light			Turbulence Medium or Heavy		
	Dielectric Rod	1.7 - 3	3 - 10	10 - 100	1.7 - 3	3 - 10
4" Horn	16 (5)	39 (12)	66 (20)	10 (3)	29 (9)	39 (12)
6" Horn	33 (10)	82 (25)	131 (40)	16 (5)	39 (12)	52 (16)

Figure 5

MOUNTING

The PULSAR Model R96 Radar transmitter can be mounted on a vessel using a variety of process connections. Generally either a threaded or flanged connection is used.

LOCATION

Ideally, the Radar transmitter should be mounted $\frac{1}{2}$ radius from center of the tank providing an unobstructed signal path to the liquid surface where it should illuminate (with microwave energy) the largest possible surface area. Do not install in center of tank top or within 18 inches (45 cm) of tank wall. Tank walls may produce reflections that must be minimized during field configuration (Antenna Orientation). Refer to Figure 7.

BEAM ANGLE

The various antenna designs exhibit different beam patterns. Figure 9 shows the beam spread for all PULSAR antennas. Ideally the beam pattern should illuminate the maximum liquid surface with a minimum striking other objects in the vessel including the tank wall. Use these drawings to determine the optimum installation location.

OBSTRUCTIONS

Almost any object that falls within the beam pattern will cause reflections that may be misinterpreted as a false liquid level. Although the PULSAR Model R96 has a powerful Echo Rejection routine, all possible precautions should be taken to minimize false target reflections with proper installation and orientation. Refer to Figures 8 & 9.

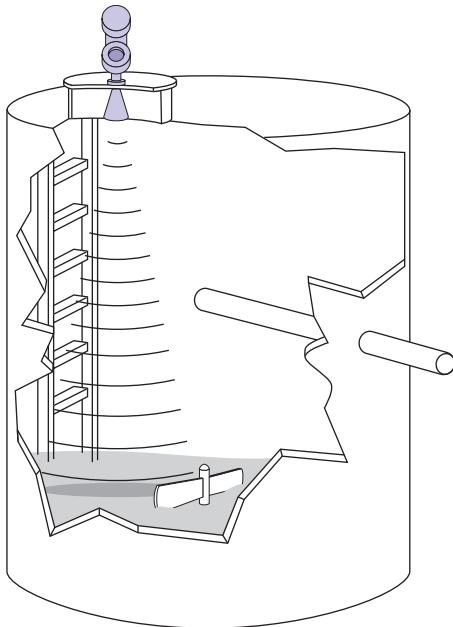


Figure 8

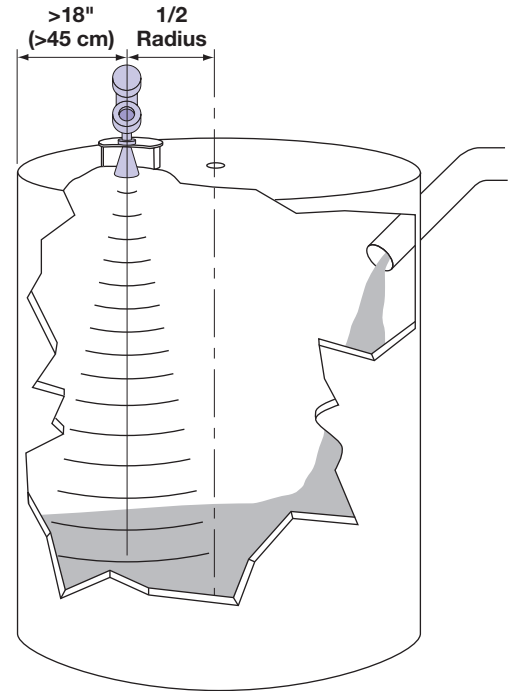
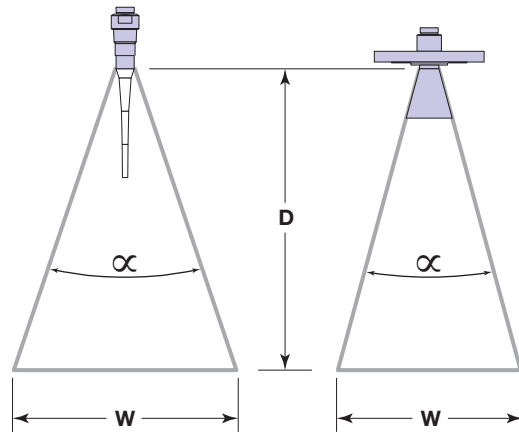


Figure 7



Antenna Beam Angle (α)	Beam Spread, W @-3dB; ft (m)		
	Dielectric Rod 25°	4" Horn 25°	6" Horn 17°
Distance, D			
10 (3)	4.5 (1.4)	3.0 (1.0)	
20 (6)	8.9 (2.7)	6.0 (1.8)	
30 (9)	13.3 (4.1)	9.0 (2.7)	
40 (12)	17.8 (5.4)	12.0 (3.7)	
50 (15)	22.2 (6.8)	15.0 (4.6)	
60 (18)	26.6 (8.1)	18.0 (5.5)	
65 (20)	28.9 (8.8)	19.5 (6.0)	
98 (30)	*	29.3 (9.0)	
130 (40)	*	39.0 (12.0)	

*Dielectric rod and 4" horn not recommended beyond 65 feet (20 meters).

Figure 9

MOUNTING

NOZZLES

Improper installation in a nozzle creates “ringing” (undesired signals) which will adversely affect measurement. The antenna should always be mounted so the active section of the antenna is a minimum of 0.5" (12 mm) below the nozzle. Be sure to include any nozzle dimension *inside* the vessel. Refer to Figure 10. Antenna extensions are offered to allow the PULSAR Model R96 transmitter to work reliably in nozzles with “L” dimensions of 1" (25 mm), 4" (100 mm), 8" (200 mm) or 12" (300 mm). Standard antennas are shown below for reference.

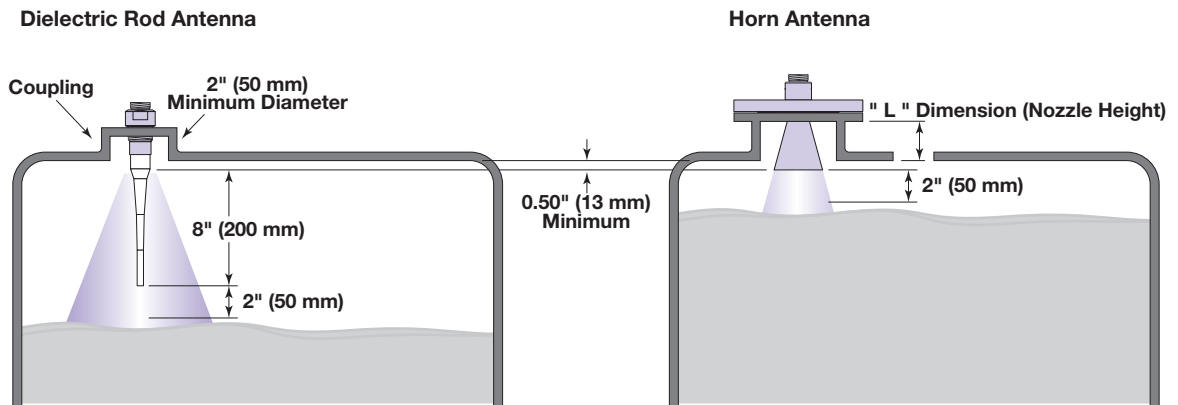
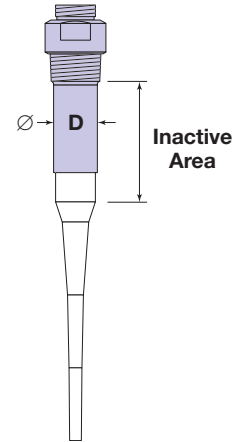
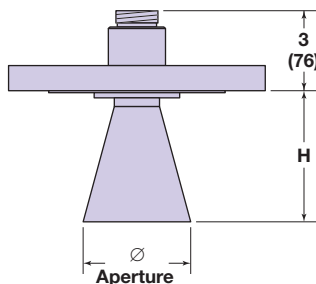
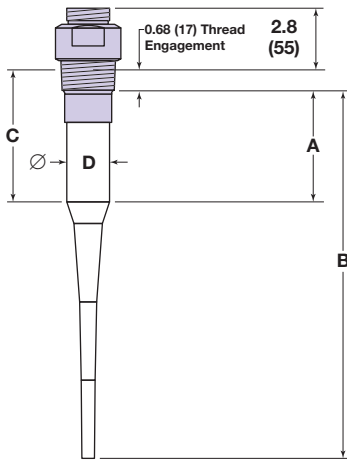


Figure 10



DIELECTRIC RODS - inches (mm)

Model #	Antenna Extension (maximum "L" dimension)	All	All	BSP
8th Digit		Dim A	Dim B	Dim C
0	1 (25)	2.2 (56)	11.1 (282)	3.0 (76)
1	4 (100)	5.1 (130)	14.0 (356)	5.9 (150)
2	8 (200)	9.1 (231)	18.0 (457)	9.9 (251)
3	12 (300)	13.1 (333)	22.0 (559)	13.9 (353)

Antenna Extension O.D. Dimension D	
TFE Rod	∅ 1.625 (41)
PP Rod	∅ 1.50 (38)
All-Plastic Rod	∅ 1.625 (41)

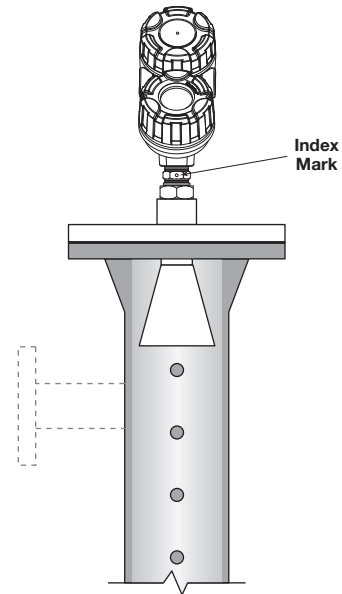
HORNS - inches (mm)

Model #	Antenna Extension (maximum "L" dimension)	3" Horn	4" Horn	6" Horn
8th Digit		Dim H	Dim H	Dim H
0	1 (25)	2.7 (51)	↓	↓
1	4 (100)	N/A		
2	8 (200)		8.4 (213)	8.3 (211)
3	12 (300)		12.4 (315)	12.4 (315)
Aperture		2.95 (75 mm)	3.75 (95)	5.75 (146)

STANDPIPES AND STILLWELLS

The PULSAR Model R96 can be mounted in a standpipe or stillwell but certain items must be considered:

- Metal stillwells only: Sizes 3–8 inches (80–200 mm).
- Diameter must be consistent throughout length; no reducers.
- Use only horn antennas sized to pipe ID; 3–6" (80–150mm); 8" pipe can use a 6" horn.
- Stillwell length must cover complete range of measurement (i.e., liquid must be in stillwell).
- Welds should be smooth.
- Vents: holes <0.5" diameter, slots <0.5" width.
- If an isolation valve is used, it must be a full port ball valve with an I.D. equal to the pipe diameter.
- Bridles/Bypass Installations: The launcher (index mark) should be rotated 90° from process connections.
- Configuration must include a non-zero entry for PIPE I.D.
- There will be some increased dielectric sensitivity; system GAIN will be reduced when PIPE ID >0.
- There will be a slight reduction in Maximum Range based on the table at right.



Maximum Range

PIPE I.D.		Propagation Speed Factor	Maximum Range	
inch	mm		feet	meters
3	80	0.915	60.0	18.3
4	100	0.955	62.7	19.1
6	150	0.98	64.3	19.6
8	200	0.99	65.0	19.8

Figure 11

MOUNTING

ORIENTATION

The PULSAR Model R96 transmitter utilizes a linearly polarized, microwave beam that can be rotated to improve its performance. Proper orientation can minimize unwanted target reflections, decrease sidewall reflections (multipath) and maximize direct reflections from the liquid surface. The index mark located on the side of the launcher is oriented in the same direction as the polarization. 45° is initially recommended. Refer to Figure 12.

The index mark is also present for reference (1 dot: GP/IS or 2 dots: XP). The launcher is considered to be at 0° when the index mark is closest to the tank wall.

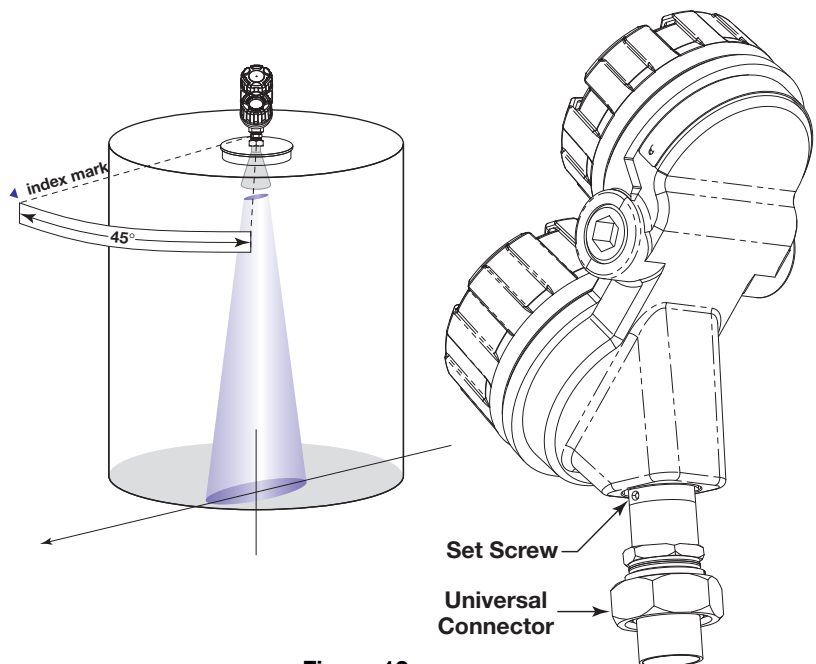


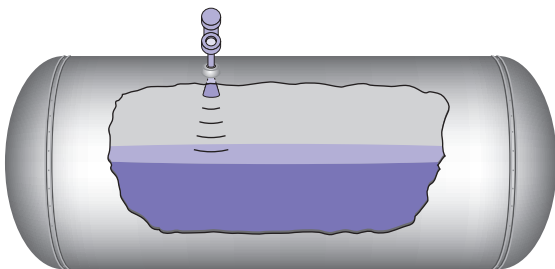
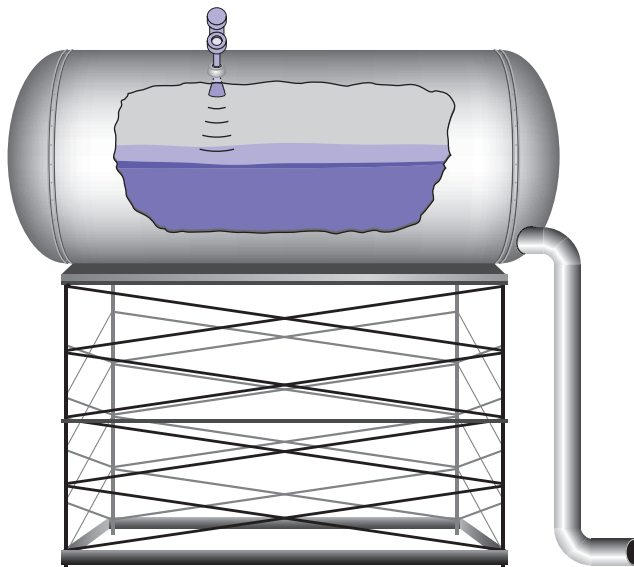
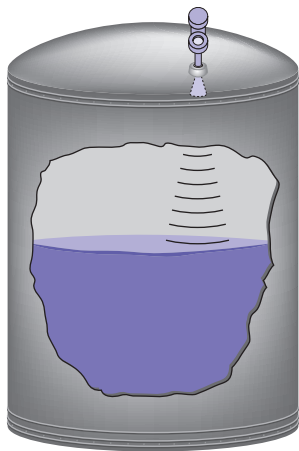
Figure 12

APPLICATIONS

PULSE BURST RADAR

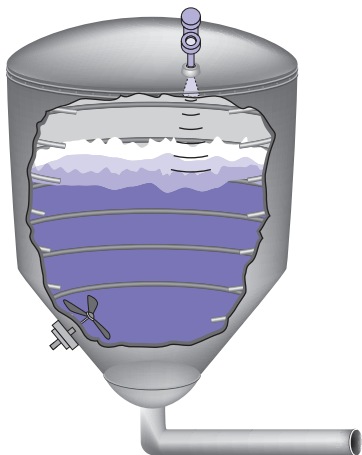
STORAGE AND INTERMEDIATE HOLDING TANKS

CONDITIONS - Calm Surfaces



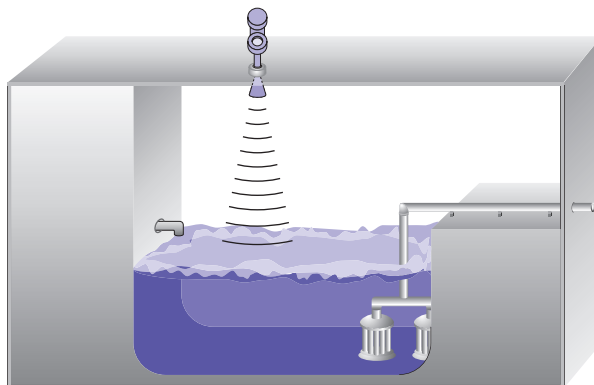
REACTORS

CONDITIONS - Turbulence and Foam



ENCLOSED SUMPS

CONDITIONS - Turbulence, Foam, and Changing Dielectric

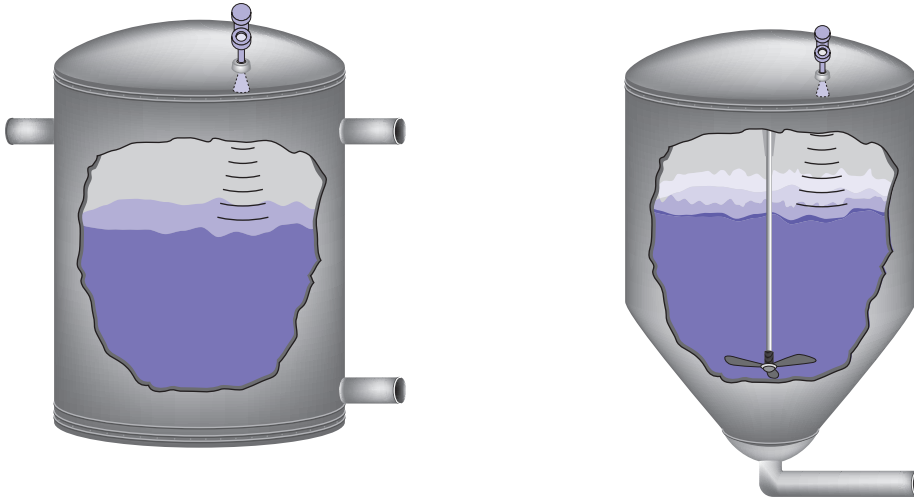


APPLICATIONS

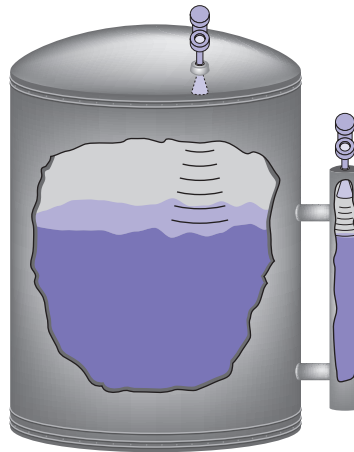
PULSE BURST RADAR

MIXERS AND BLENDING VESSELS

CONDITIONS – Turbulence, Foam, and Changing Dielectric



CHAMBERS AND BYPASS



PROBLEMATIC APPLICATIONS

GUIDED WAVE RADAR ALTERNATIVE

Some applications can be problematic for Non-Contact Radar. The following are examples of when Guided Wave Radar is recommended.

- Extremely low dielectric media ($\epsilon_r < 1.7$)
- Very weak reflections from the liquid surface (particularly during turbulence) can cause poor performance.
- Tanks heavily cluttered with false targets (mixers, pumps, ladders, pipes, etc.)
- During times of very low liquid levels of low dielectric media, the metal tank bottom may be detected, which can deteriorate performance.

- Foam can either absorb or reflect the microwave energy depending upon the depth, dielectric, density and wall thickness of the bubbles. Due to typical variations in the amount (depth) of foam, it is impossible to quantify performance. It may be possible to receive most, some or none of the transmitted energy.
- Extremely high liquid level (Overflow) conditions when liquid very near the antenna can cause erroneous readings and measurement failure.

Refer to ECLIPSE Model 706 Guided Wave Radar bulletin 57-106.

AGENCY APPROVALS



These units are in compliance with the EMC-directive 2004/108/EC, the PED-directive 97/23/EC and the ATEX directive 94/9/EC.
IEC 60079-0: 2001 IEC 60079-15: 2010 IEC 60079-26: 2006

<p>Explosion Proof US/Canada: Class I, Div 1, Group B, C, D, T4 Class I, Zone 1 A Ex db ia IIB+H2 T4 Class I, Zone 1 Ex d ia IIB+H2 T4 Ta = -40° C to +70° C Type 4X, IP67</p> <p>Flame Proof ATEX – FM14ATEX0058X II 1/2 G Ex db ia IIB + H2 T4... T1 Gb/Ga Ta = -40° C to +70° C IP67</p> <p>IEC- IECEX FMG 15.0034X Ex db ia IIB + H2 T4...T1 Gb/Ga Ta = -40° C to +70° C IP67</p>	<p>Non- Incendive US/Canada: Class I, II, III, Div 2, Group A, B, C, D, E, F, G, T6 Class 1, Zone 2 AEx nA ia IIC T4 Class 1, Zone 2 Ex nA ia IIC T4 Ta = -40° C to +70° C Type 4X, IP67</p> <p>ATEX - FM14ATEX0058X II 3 G Ex nA IIC Gc T6 Ta = -15° C to +70° C IP67</p> <p>IEC – IECEX FMG 15.0034X Ex nA IIC Gc T6 Ta = -15° C to + 70° C IP67</p>
<p>Intrinsically Safe US/Canada: Class I, II, III, Div 1, Group A, B, C, D, E, F, G, T4 Class I, Zone 0 AEx ia IIC T4 Class I, Zone 0 Ex ia IIC T4 Ga Ta = -40° C to + 70° C Type 4X, IP67</p> <p>ATEX – FM14ATEX0058X: II 1 G Ex ia IIC T4 Ga Ta = -40° C to +70° C IP67</p> <p>IEC – IECEX FMG 15.0034X: Ex ia IIC T4 Ga Ta = -40° C to +70° C IP67</p>	<p>Dust Ignition Proof US/Canada: Class II, III, Div 1, Group E, F, and G, T5 Ta = -15° C to +70° C Type 4X, IP67</p> <p>ATEX – FM14ATEX0059X: II 2 D Ex ia tb IIIC T110° C Db Ta = -15° C to +70° C IP67</p> <p>IEC – IECEX FMG 15.0034X: Ex ia tb IIIC 100° C Db Ex ia IIIC T85° C to T450° C Da Ta = -15° C to +70° C IP67</p>

FM3600:2011, FM3610:2010, FM3611:2004, FM3615:2006, FM3616:2011, FM3810:2005, ANSI/ISA60079-0:2013, ANSI/ISA 60079-1:2015, ANSI/ISA 60079-11:2013, ANSI/ISA 60079-15:2012, ANSI/ISA 60079-26:2011, NEMA 250:2003, ANSI/IEC 60529:2004, C22.2 No. 0.4:2009, C22.2 No. 0.5:2008, C22.2 No. 30:2007, C22.2 No. 94:2001, C22.2 No. 213:2012, C22.2 No. 1010.1:2009, CAN/CSA 60079-0:2011, CAN/CSA 60079-1:2011, CAN/CSA 60079-11:2014, CAN/CSA 60079-15:2012, C22.2 No. 60529:2005, EN60079-0:2012, EN60079-1:2014, EN60079-11:2012, EN60079-15:2010, EN60079-26:2007, EN60079-31:2009, EN60529+A1:1991-2000, IEC60079-0:2011, IEC60079-1:2014, IEC60079-11:2011, IEC60079-15:2010, IEC60079-26:2006, IEC60079-31:2008

“This equipment with chargeable non-conductive parts, e.g. enclosure’s paint and antenna use PTFE, Co-polymer Polypropylene or Noryl En265, is provided with a warning label referring to the safety measures that must be taken if there is electrostatic charging during operation. For use in hazardous area, the equipment and side to be installed, e.g. tank, must be connected to earth and be attention to not only the measuring object, e.g. liquids, gases, powders and etc., but also the related conditions, e.g. tank container, vessel and etc. (According to IEC 60079- 32-1).”

FCC (ID# LPN-R9C) Compliance Statement:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause in harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment. To comply with FCC/IC RF exposure limits for general population/uncontrolled exposure, the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

TRANSMITTER SPECIFICATIONS

FUNCTIONAL/PHYSICAL

System Design

Measurement Principle	Pulse burst radar 6 GHz
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Input

Measured Variable	Level, determined by the time-of-flight of radar pulse reflections
Span	0.5 to 130 feet (0.2 to 40 meters)

Output

Type	4 to 20 mA with HART: 3.8 mA to 20.5 mA useable (per NAMUR NE43) FOUNDATION fieldbus™: H1 (ITK Ver. 6.1.2)
Resolution	Analog .003 mA Digital Display 1 mm
Loop Resistance	591 ohms @ 24 VDC and 22 mA
Diagnostic Alarm	Selectable: 3.6 mA, 22 mA (meets requirements of NAMUR NE 43), or HOLD last output
Diagnostic Indication	Meets requirements of NAMUR NE107
Damping	Adjustable 0-10

User Interface

Keypad	4-button menu-driven data entry
Display	Graphic Liquid Crystal Display
Digital Communication	HART Version 7—with Field Communicator, FOUNDATION fieldbus™, AMS, or FDT DTM (PACTware™), EDDL
Menu Languages	Transmitter LCD: English, French, German, Spanish, Russian HART DD: English, French, German, Spanish, Russian, Chinese, Portuguese FOUNDATION fieldbus Host System: English

Power (Measured at instrument terminals)

	HART: General Purpose (Weather proof)/Intrinsically Safe/Explosion-proof: 11 VDC minimum under certain conditions (refer to I/O Manual 58-602) FOUNDATION fieldbus™: 9 to 17.5 VDC FISCO, FNICO, Explosion Proof, General Purpose and Weather Proof
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Housing

Material	IP67/die-cast aluminum A413 (<0.6% copper); optional stainless steel
Net/Gross Weight	Aluminum: 4.5 lbs. (2.0 kg) Stainless Steel: 10.0 lbs. (4.50 kg)
Overall Dimensions	H 8.34" (212 mm) × W 4.03" (102 mm) × D 7.56" (192 mm)
Cable Entry	½" NPT or M20
SIL 2 Hardware (Safety Integrity Level)	Safe Failure Fraction = 92.7% (HART only) Functional Safety to SIL 2 as 1oo1 in accordance with IEC 61508 (Full FMEDA report available upon request)

ENVIRONMENT

Operating Temperature	-40° to +175° F (-40° to +80° C); LCD viewable -5° to +160° F (-20° to +70° C)
Storage Temperature	-50° to +185° F (-45° to +85° C)
Humidity	0–99%, non-condensing
Electromagnetic Compatibility	Meets CE requirement (EN 61326) and NAMUR NE 21 NOTE: Antennas must be used in metallic or concrete vessel or stillwell to maintain CE noise immunity
Surge Protection	Meets CE EN 61326 (1000V)
Shock/Vibration	ANSI/ISA-S71.03 Class SA1 (Shock); ANSI/ISA-S71.03 Class VC2 (Vibration)

PERFORMANCE

Reference Conditions	Reflection from ideal reflector at +70° F (+20° C)	
Linearity	±0.3 inch (8 mm) or 0.1% of tank height (whichever is greater)	
Measured Error	±0.3 inch (8 mm) or 0.1% of tank height (whichever is greater) (Performance will degrade slightly within 60" (1.5 m) of antenna)	
Resolution	0.1 inch or 1mm	
Repeatability	±0.2 inch (5 mm) or 0.05% of tank height (whichever is greater)	
Response Time	<2 seconds (configuration dependent)	
Initialization Time	< 30 seconds	
Ambient Temperature Effect	Digital	Horn Antenna: Average 0.12 inch (3 mm) / 10 K, max of ±0.4 inch (10 mm) over the entire temperature range -40° to +175° F (-40° to +80° C) Rod Antenna: Average 0.2 inch (5 mm) / 10 K, max of ±0.59 inch (15 mm) over the entire temperature range -40° to +175° F (-40° to +80° C)
		Analog Current Output (additional error with reference to 16 mA span) Average 0.03% / 10 K. max 0.45% over entire temperature range -40° to +175° F (-40° to +80° C)
Maximum Rate of Change	180 inches (450 cm)/minute	

FOUNDATION fieldbus™ :

ITK Version	6.1.2
H1 Device Class	Link Master (LAS)—selectable ON/OFF
H1 Profile Class	31PS, 32L
Function Blocks	(6) AI, (2) Transducer, (1) Resource, (1) Arithmetic, (1) Signal Characterizer, (2) PID, (1) Input Selector
Quiescent Current	17 mA
Execution Time	15 ms (30 ms PID Block)
Device Revision	01
DD Version	0x01

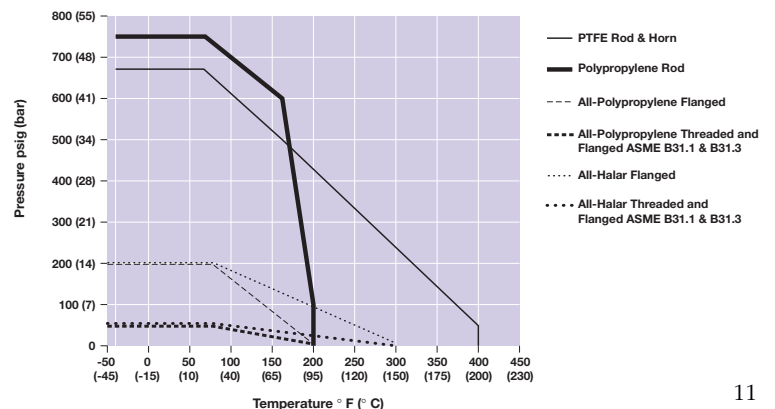
ANTENNA SPECIFICATIONS

FUNCTIONAL / PHYSICAL

Model	Dielectric Rod TFE	Dielectric Rod ① Polypropylene	Dielectric Rod All-Halar® Antenna	3", 4", and 6" Horn
Materials	316 SS (Hastelloy® C, Monel® and Kynar® opt.), TFE, Viton® O-rings	316 SS, Polypropylene, Viton® O-rings	All-Halar, Viton® O-rings	316 SS (Hastelloy C and Monel opt.), TFE, Viton® O-rings
Process Connection	1½" NPT and BSP, ANSI or DIN flanges	1½" NPT and BSP, ANSI or DIN flanges	1½" NPT and BSP, ANSI or DIN flanges	6" ANSI or DIN flanges
Maximum Process Temperature	+400° F @ 50 psig (+200° C @ 3.5 bar)	+200° F @ 50 psig (+95° C @ 3.5 bar)	+300° F @ atmos (+150° C @ atmos)	+400° F @ 50 psig (+200° C @ 3.5 bar)
Maximum Process Pressure	-14.7 to 675 psig @ +70° F (-1.0 to 46.5 bar @ +20° C)	-14.7 to 750 psig @ +70° F (-1.0 to 51.7 bar @ +20° C)	-14.7 to 50 psig @ +70° F (-1.0 to 3.45 bar @ +20° C)	-14.7 to 675 psig @ +70° F (-1.0 to 46.5 bar @ +20° C)
Minimum Dielectric (application dependent)	2.0	2.0	2.0	1.7 (1.4 with stillwells)

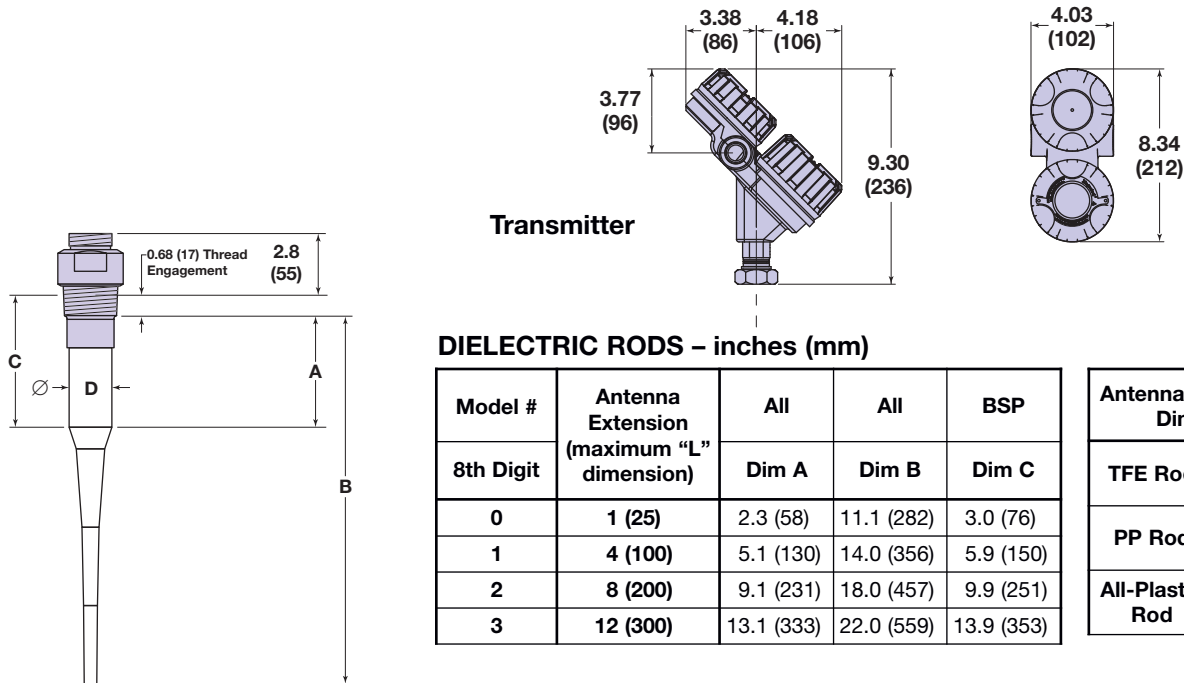
① All-polypropylene construction optional (see chart below for ratings)

TEMPERATURE / PRESSURE CHART



DIMENSIONAL SPECIFICATIONS

INCHES (MM)



DIELECTRIC RODS – inches (mm)

Model #	Antenna Extension (maximum "L" dimension)	All	All	BSP
8th Digit		Dim A	Dim B	Dim C
0	1 (25)	2.3 (58)	11.1 (282)	3.0 (76)
1	4 (100)	5.1 (130)	14.0 (356)	5.9 (150)
2	8 (200)	9.1 (231)	18.0 (457)	9.9 (251)
3	12 (300)	13.1 (333)	22.0 (559)	13.9 (353)

Antenna Extension O.D. Dimension D	
TFE Rod	∅ 1.625 (41)
PP Rod	∅ 1.50 (38)
All-Plastic Rod	∅ 1.625 (41)

HORNS – inches (mm)

Model #	Antenna Extension (maximum "L" dimension)	3" Horn	4" Horn	6" Horn	
8th Digit		Dim H	Dim H	Dim H	
0	1 (25)	2.7 (51)	↓	↓	
1	4 (100)	N/A	4.6 (117)	↓	
2	8 (200)		8.4 (213)		8.3 (211)
3	12 (300)		12.4 (315)		12.4 (315)
Aperture		2.95 (75)	3.75 (95)	5.75 (146)	

O - R I N G (S E A L) S E L E C T I O N C H A R T

Material	Code	Maximum Temperature	Maximum Pressure	Min. Temp.	Recommended For Use In	Not Recommended For Use In
Viton® GFLT	0	+400° F @ 232 psig (+200° C @ 16 bar)	750 psig @ +70° F (51.7 bar @ +20° C)	-40° F (-40° C)	General purpose, steam, ethylene	Ketones (MEK, acetone), skydrol fluids, amines, anhydrous ammonia, low molecular weight esters and ethers, hot hydrofluoric or chlorosulfuric acids, sour HCs
EPDM	1	+250° F @ 200 psig (+125° C @ 14 bar)	750 psig @ +70° F (51.7 bar @ +20° C)	-60° F (-50° C)	Acetone, MEK, skydrol fluids anhydrous ammonia	Petroleum oils, di-ester base lubricants, propane, steam
Kalrez® (4079)	2	+400° F @ 232 psig (+200° C @ 16 bar)	750 psig @ +70° F (51.7 bar @ +20° C)	-40° F (-40° C)	Inorganic and organic acids (including HF and nitric), aldehydes, ethylene, glycols, organic oils, silicone oils, vinegar, sour HCs	Black liquor, hot water/steam, hot aliphatic amines, ethylene oxide, propylene oxide, molten sodium, molten potassium
Simriz SZ485 (formerly Aegis PF128)	8	+400° F @ 232 psig (+200° C @ 16 bar)	750 psig @ +70° F (51.7 bar @ +20° C)	-4° F (-20° C)	Inorganic and organic acids (including HF and nitric), aldehydes, ethylene, glycols, organic oils, silicone oils, vinegar, sour HCs, steam, amines, ethylene oxide, propylene oxide	Black liquor, Freon 43, Freon 75, Galden, KEL-F liquid, molten sodium, molten potassium

TRANSMITTER

MODEL NUMBER

Models available for quick shipment, usually within one week after factory receipt of a complete purchase order, through the Expedite Ship Plan (ESP).



1 | BASIC MODEL NUMBER

R96	Through-Air Radar Level Transmitter- 6 GHz Pulse Radar
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4 | POWER

5	24 VDC, Two-wire
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5 | SIGNAL OUTPUT

1	4–20 mA with HART
2	FOUNDATION fieldbus

6 | SAFETY OPTIONS

0	None (FOUNDATION fieldbus only) (5th digit = 2)
1	SIL 2 Hardware - HART only (5th digit = 1)

7 | ACCESSORIES

0	No Digital Display and Keypad
A	Digital Display and Keypad

8 | CLASSIFICATION

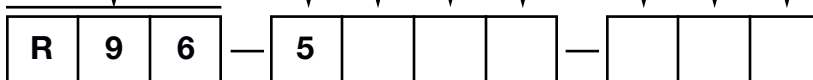
0	General Purpose, Weatherproof (IP 67)
1	Intrinsically Safe (FM & CSA)
3	Explosion-proof (FM & CSA)
A	Intrinsically Safe (ATEX/IEC)
B	Flame-proof (ATEX/IEC)
C	Non-sparking (ATEX)
D	Dust Ignition Proof

9 | HOUSING

1	Die-cast Aluminum, Dual-compartment, 45-degree
2	Investment Cast, Stainless Steel, Dual-compartment, 45-degree

10 | CONDUIT CONNECTION

0	½" NPT
1	M20
2	½" NPT with sunshade
3	M20 with sunshade



RADAR ANTENNAS

DIELECTRIC ROD MODEL NUMBER

TECHNOLOGY / OPERATING FREQUENCY

R A	PULSAR radar antennas / 6 GHz
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CONFIGURATION / STYLE

A	TFE (Material of Construction codes A, B, C, and K only)
B	Polypropylene (Material of Construction codes A, G, K, and L only)
C	Halar® (Material of Construction codes G and L only)

MATERIAL OF CONSTRUCTION

A	316/316L stainless steel
B	Hastelloy® C
C	Monel®
G	All-Plastic wetted surfaces including flanges (Configuration/Style codes B and C only)
K	316/316L SS; ASME B31.1 and B31.3 (meets CRN specifications)
L	All-Plastic wetted surfaces; ASME B31.1, B31.3 (meets CRN specifications; Configuration/Style codes B and C, flanged only)

PROCESS CONNECTION - SIZE/TYPE ①

Threaded

31	1½" NPT thread
32	1½" BSP (G 1½) thread

ANSI Flanges

EN (DIN) Flanges

43	2" 150# ANSI raised face flange	DA	DN 50, PN 16	EN 1092-1 Type A
44	2" 300# ANSI raised face flange	DB	DN 50, PN 25/40	EN 1092-1 Type A
45	2" 600# ANSI raised face flange	DD	DN 50, PN 63	EN 1092-1 Type B2
53	3" 150# ANSI raised face flange	EA	DN 80, PN 16	EN 1092-1 Type A
54	3" 300# ANSI raised face flange	EB	DN 80, PN 25/40	EN 1092-1 Type A
55	3" 600# ANSI raised face flange	ED	DN 80, PN 63	EN 1092-1 Type B2
63	4" 150# ANSI raised face flange	FA	DN 100, PN 16	EN 1092-1 Type A
64	4" 300# ANSI raised face flange	FB	DN 100, PN 25/40	EN 1092-1 Type A
65	4" 600# ANSI raised face flange	FD	DN 100, PN 63	EN 1092-1 Type B2
73	6" 150# ANSI raised face flange	GA	DN 150, PN 16	EN 1092-1 Type A
74	6" 300# ANSI raised face flange	GB	DN 150, PN 25/40	EN 1092-1 Type A
75	6" 600# ANSI raised face flange	GD	DN 150, PN 63	EN 1092-1 Type B2

HYGIENIC PROCESS CONNECTIONS

4P	2" Tri-Clamp® type, 16 AMP	6P	4" Tri-Clamp type, 16 AMP
5P	3" Tri-Clamp type, 16 AMP	7P	6" Tri-Clamp type, 16 AMP

① Metal flanges welded to antenna; Plastic flanges and metal flanges with threaded antenna connection ordered separately. Refer to Optional Flanges chart on page 15.

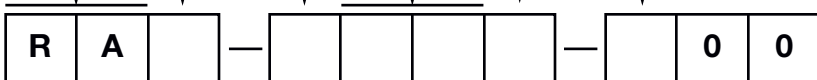
O-RINGS ②

0	Viton® GFLT
1	EPDM
2	Kalrez 4079
8	Simriz SZ485 (formerly Aegis PF128)

② All-Polypropylene and All-Halar antennas (Materials of Construction Codes G and L) use Viton® GFLT O-rings

ANTENNA EXTENSION

0	For nozzle height ≤ 1" (25 mm) (For threaded process connection only)
1	For nozzle height ≤ 4" (100 mm)
2	For nozzle height ≤ 8" (200 mm) (ESP designation for TFE rod only)
3	For nozzle height ≤ 12" (300 mm)



RADAR ANTENNAS

HORN MODEL NUMBER

TECHNOLOGY / OPERATING FREQUENCY

RA	PULSAR radar antennas / 6 GHz
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CONFIGURATION / STYLE

3	3" horn (for Standpipe/Stillwell use only; Materials of Construction codes A & K only)
4	4" horn
6	6" horn

MATERIAL OF CONSTRUCTION

A	316/316L stainless steel
B	Hastelloy C
K	316/316L SS; ASME B31.1 and ASME B31.3 (meets CRN specifications)



PROCESS CONNECTION - SIZE/TYPE (metal flanges welded to antenna)

ANSI Flanges

EN (DIN) Flanges

53	3" 150# ANSI raised face flange	EA	DN 80, PN 16	EN 1092-1 Type A
54	3" 300# ANSI raised face flange	EB	DN 80, PN 25/40	EN 1092-1 Type A
55	3" 600# ANSI raised face flange	ED	DN 80, PN 63	EN 1092-1 Type B2
63	4" 150# ANSI raised face flange	FA	DN 100, PN 16	EN 1092-1 Type A
64	4" 300# ANSI raised face flange	FB	DN 100, PN 25/40	EN 1092-1 Type A
65	4" 600# ANSI raised face flange	FD	DN 100, PN 63	EN 1092-1 Type B2
73	6" 150# ANSI raised face flange	GA	DN 150, PN 16	EN 1092-1 Type A
74	6" 300# ANSI raised face flange	GB	DN 150, PN 25/40	EN 1092-1 Type A
75	6" 600# ANSI raised face flange	GD	DN 150, PN 63	EN 1092-1 Type B2

HYGIENIC PROCESS CONNECTIONS

6P	4" Tri-Clamp® type, 16 AMP Hygienic Flange
7P	6" Tri-Clamp type, 16 AMP Hygienic Flange

O-RINGS

0	Viton® GFLT
1	EPDM
2	Kalrez 4079
8	Simriz SZ485 (formerly Aegis PF128)

ANTENNA EXTENSION

0	For 3" Horn in standpipes/stillwells only
1	For nozzle height ≤ 4" (100 mm) - Configuration Style code 4 only
2	For nozzle height ≤ 8" (200 mm)
3	For nozzle height ≤ 12" (300 mm)



OPTIONAL FLANGES

(for use with Dielectric Rod Antennas; Extension Codes 1-3 only)

Part Number: 004-6852	2"		3"		4"		6"	
	150#	300#	150#	300#	150#	300#	150#	300#
316L stainless steel	-001	-005	-002	-006	-003	-007	-004	-008
304L stainless steel	-009	-013	-010	-014	-011	-015	-012	-016
Carbon steel	-017	-021	-018	-022	-019	-023	-020	-024
Hastelloy C	-025	-029	-026	-030	-027	-031	-028	-032
Monel	-033	-037	-034	-038	-035	-039	-036	-040
Kynar	-041	-045	-042	-046	-043	-047	-044	-048
PVC	-049	-053	-050	-054	-051	-055	-052	-056
Polypropylene	-057	-061	-058	-062	-059	-063	-060	-064
TFE	-065	-069	-066	-070	-067	-071	-068	-072

QUALITY



The quality assurance system in place at MAGNETROL guarantees the highest level of quality throughout the company. MAGNETROL is committed to providing full customer satisfaction both in quality products and quality service.

The MAGNETROL quality assurance system is registered to ISO 9001 affirming its commitment to known international quality standards providing the strongest assurance of product/service quality available.

ESP

Expedite **S**hip **P**lan

Several PULSAR Through-Air Radar Level Transmitters are available for quick shipment, usually within one week after factory receipt of a complete purchase order, through the Expedite Ship Plan (ESP). Models covered by ESP service are color coded in the selection data charts.

To take advantage of ESP, simply match the color coded model number codes (standard dimensions apply). ESP service may not apply to orders of ten units or more. Contact your local representative for lead times on larger volume orders, as well as other products and options.

WARRANTY



All MAGNETROL electronic level and flow controls are warranted free of defects in materials or workmanship for one full year from the date of original factory shipment. If returned within the warranty period; and, upon factory inspection of the control, the cause of the claim is determined to be covered under the warranty; then, MAGNETROL will repair or replace the control at no cost

to the purchaser (or owner) other than transportation.

MAGNETROL shall not be liable for misapplication, labor claims, direct or consequential damage or expense arising from the installation or use of equipment. There are no other warranties expressed or implied, except special written warranties covering some MAGNETROL products.

For additional information, see Instruction Manual 58-602.

PULSAR Pulse Burst Radar transmitters may be protected by one or more of the following U.S. Patent Nos.: US 6,062,095; US 6,980,174; US 7,102,584; US 7,106,248; US 7,271,646



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